Quantifying the health benefits of reducing concentrations of ambient particulate matter (PM): Why we cannot do it yet.

Laura C. Green, Ph.D., D.A.B.T., Michael R. Ames, Sc.D.,
Sarah R. Armstrong, M.S., M.S., and Edmund A.C. Crouch, Ph.D.,
Cambridge Environmental Inc.

Corresponding author: Green@CambridgeEnvironmental.com

No one knows whether reducing current ambient air concentrations of typical, inhalable, particulate matter (PM_{10}, $PM_{2.5}$, etc.) will prolong life and reduce illness; and, for several reasons, many people are skeptical. Current "externality" models that predict reductions in mortality as a result of reducing ambient air concentrations of PM *per force* depend on toxicologic assumptions that are either highly uncertain or clearly incorrect, and so fail to incorporate realistic estimates of their uncertainty. In particular, such models assume that:

- $PM_{2.5}$ at current levels in ambient air causes or exacerbates fatal disease(s);
- All components of $PM_{2.5}$ are equally toxic;
- Average mass concentrations of total ambient $PM_{2.5}$ are relevant, accurate measures for estimating effects on mortality; and
- Decreasing the mass concentration of any form of ambient $PM_{2.5}$ will decrease rates of death in a reliably quantifiable fashion.

None of these assumptions is known to be correct. The first is consistent with some (but not all) of the epidemiologic evidence, but not consistent with toxicologic evidence. The last three have not been (and perhaps cannot be) examined epidemiologically, and are not consistent with toxicologic evidence. Moreover, even if some specific components of ambient PM are toxic at current levels, many attempts to reduce PM mass concentrations in "PM non-attainment" areas may well increase risks to public health. This presentation (1) details the toxicologic problems with current PM-mortality models, (2) demonstrates that such models cannot provide meaningful estimates of public health benefits, and (3) proposes specific, epidemiologic and toxicologic research that might allow for the future creation of reasonably reliable, evidence-based models.